

Claims

1. Apparatus for providing optical radiation, which apparatus comprises a pump source for providing pump radiation, and a brightness converter, the apparatus being characterised in that the brightness converter contains a substantially rigid region along at least a portion of its length.
2. Apparatus according to claim 1 wherein the brightness converter comprises a core, a first cladding, rare earth dopant, a first end, and a second end.
3. Apparatus according to claim 2 wherein the brightness converter comprises a tapered region located between the first end and the second end, the apparatus being characterised in that the cross-sectional area of the first end is greater than the cross-sectional area of the second end, and the brightness converter is substantially rigid between the first end and the tapered region.
4. Apparatus according to any one of the preceding claims wherein the pump radiation is coupled from the pump source into the brightness converter using a coupling means.
5. Apparatus according to claim 4 wherein the coupling means is a lens.
6. Apparatus according to any one of claims 2 to 5 wherein the apparatus comprises a first reflector for reflecting optical radiation emerging from the first end.
7. Apparatus according to any one of the preceding claims and including a second reflector.
8. Apparatus according to any one of the preceding claims wherein the pump source comprises at least one laser diode, laser diode bar, laser diode stack, or a laser diode mini-bar stack.

- 1 9. Apparatus according to any one of the preceding claims wherein the pump
2 source includes a solid-state laser, a gas laser, an arc lamp, or a flash lamp.
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- 4 10. Apparatus according to any one of the preceding claims wherein the apparatus
5 comprises a plurality of the pump sources and a combining means for
6 combining the pump radiation emitted by the pump sources.
7
- 8 11. Apparatus according to claim 10 wherein the combining means comprises a
9 beam splitter, a reflector, a polarisation beam combiner, a beam shaper, a
10 wavelength division multiplexer, or a plurality of optical fibres in optical contact
11 along at least a portion of their length.
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- 13 12. Apparatus according to any one of the preceding claims wherein the brightness
14 converter contains a plurality of cores.
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- 16 13. Apparatus according to any one of claims 1 to 11 wherein the brightness
17 converter contains a single core.
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- 19 14. Apparatus according to any one of the preceding claims wherein the brightness
20 converter is circular.
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- 22 15. Apparatus according to any one of claims 1 to 13 wherein the brightness
23 converter is non-circular.
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- 25 16. Apparatus according to any one of the preceding claims wherein the brightness
26 converter comprises rare-earth dopant.
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- 28 17. Apparatus according to claim 16 wherein the rare earth dopant is selected from
29 the group comprising Ytterbium, Erbium, Neodymium, Praseodymium, Thulium,
30 Samarium, Holmium, Dysprosium, Erbium codoped with Ytterbium, or
31 Neodymium codoped with Ytterbium.
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- 1 18. Apparatus according to claim 2 or to claim 2 and any claim dependant on claim
2 2 wherein the brightness converter comprises a second cladding.
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- 4 19. Apparatus according to any one of the preceding claims wherein the brightness
5 converter is doped with neodymium and/or ytterbium, and the waveguide is
6 doped with ytterbium, erbium, or erbium co-doped with ytterbium.
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- 8 20. Apparatus according to any one of the preceding claims comprising a
9 waveguide that is pumped by the brightness converter.
10
- 11 21. Apparatus according to any one of the preceding claims wherein the brightness
12 converter is defined by a width, and wherein the width is in the range 0.1mm to
13 100mm.
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- 15 22. Apparatus according to claim 21 wherein the width is in the range 0.2mm to
16 25mm.
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- 18 23. Apparatus according to claim 22 wherein the width is in the range 5mm to
19 15mm.
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- 21 24. Apparatus according to any one of the preceding claims wherein the brightness
22 converter is defined by a breadth, and wherein the breadth is in the range
23 0.1mm to 100mm.
24
- 25 25. Apparatus according to claim 24 wherein the breadth is in the range 0.2mm to
26 25mm.
27
- 28 26. Apparatus according to claim 25 wherein the breadth is in the range 2mm to
29 15mm.
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- 31 27. Apparatus according to any one of the preceding claims wherein the brightness
32 converter is defined by a length, and wherein the length is in the range 1mm to
33 2000mm.
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- 1 28. Apparatus according to claim 27 wherein the length is in the range 10mm to
2 200mm.
3
- 4 29. Apparatus according to claim 28 wherein the length is in the range 10mm to
5 50mm.
6
- 7 30. Apparatus according to any one of the preceding claims wherein the brightness
8 converter is formed from an optical fibre preform.
9
- 10 31. Apparatus according to claim 30 wherein the preform is made from silica, silicic,
11 phosphate or phosphatic glass.
12
- 13 32. Apparatus according to claim 30 or claim 31 wherein the preform contains
14 longitudinally extended holes.
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- 16 33. Apparatus according to claim 32 wherein the preform includes stress rods.
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- 18 34. Apparatus according to any one of the preceding claims and in the form of a
19 laser, a Q-switched fibre laser, a master oscillator power amplifier, or a laser
20 that contains a frequency converter.
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